PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : B32B 5/18, B65D 65/40 — A1

(11) International Publication Number: **WO 95/15257**

(43) International Publication Date: 8 June 1995 (08.06.95)

(21) International Application Number: PCT/SE94/01145

(22) International Filing Date: 29 November 1994 (29.11.94)

(30) Priority Data:
9303966-7 30 November 1993 (30.11.93) SE

(71) Applicant: PLM AB [SE/SE]; Djäknegatan 16, S-201 80 Malmö (SE).

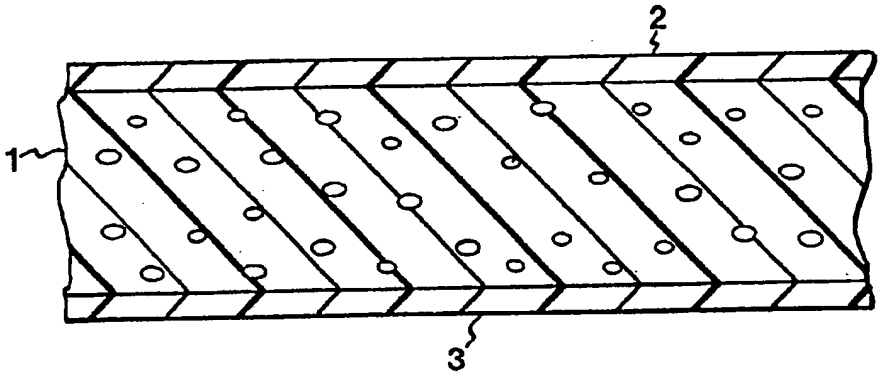
(72) Inventor: QUASTERS, Mikael; Fristilsvägen 26, S-531 55 Lidköping (SE).

(74) Agent: AWAPATENT AB; Box 5117, S-200 71 Malmö (SE).

(81) Designated States: DE, DE (Utility model), DK, DK (Utility model), FI, FI (Utility model), NO, PL, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
In English translation (filed in Swedish).

(54) Title: PACKAGING MATERIAL, METHOD FOR PRODUCING IT, CONTAINER MADE OF SUCH A MATERIAL, AND USE OF THE MATERIAL FOR MAKING THE CONTAINER



(57) Abstract

A flexible packaging material for making dimensionally-stable containers, intended especially for food and exhibiting barrier qualities, comprises a stiffening, polymeric core layer (1) which on both sides has a protective layer (2, 3) of polymeric material connected thereto. The core layer (1) consists of a foamed thermoplastic and has a thickness that makes up about 70-95 % of the total thickness of the material, while the protective layer or layers (2, 3) consist of non-foamed thermoplastic and make up the remainder of the thickness of the material. A container made of this material has a trough element with a circumferential flange, as well as a lid element with a corresponding circumferential flange. These flanges are applicable against each other, and at least the one flange is provided with an adhesive for original sealing of the container. In a method for producing the packaging material, the core layer (1) is brought to a viscosity (iv) of 0.68-0.72. The lamination is so controlled that the difference in viscosity (iv) between the core layer (1) and the protective layers (2, 3) at all times exceeds 0.04. The packaging material is primarily used for making dimensionally-stable liquid-tight containers, which are produced by thermoforming or other mechanical processing and which exhibit barrier qualities.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	**GB**	United Kingdom	**MR**	Mauritania
AU	Australia	**GE**	Georgia	**MW**	Malawi
BB	Barbados	**GN**	Guinea	**NE**	Niger
BE	Belgium	**GR**	Greece	**NL**	Netherlands
BF	Burkina Faso	**HU**	Hungary	**NO**	Norway
BG	Bulgaria	**IE**	Ireland	**NZ**	New Zealand
BJ	Benin	**IT**	Italy	**PL**	Poland
BR	Brazil	**JP**	Japan	**PT**	Portugal
BY	Belarus	**KE**	Kenya	**RO**	Romania
CA	Canada	**KG**	Kyrgystan	**RU**	Russian Federation
CF	Central African Republic	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CG	Congo			**SE**	Sweden
CH	Switzerland	**KR**	Republic of Korea	**SI**	Slovenia
CI	Côte d'Ivoire	**KZ**	Kazakhstan	**SK**	Slovakia
CM	Cameroon	**LI**	Liechtenstein	**SN**	Senegal
CN	China	**LK**	Sri Lanka	**TD**	Chad
CS	Czechoslovakia	**LU**	Luxembourg	**TG**	Togo
CZ	Czech Republic	**LV**	Latvia	**TJ**	Tajikistan
DE	Germany	**MC**	Monaco	**TT**	Trinidad and Tobago
DK	Denmark	**MD**	Republic of Moldova	**UA**	Ukraine
ES	Spain	**MG**	Madagascar	**US**	United States of America
FI	Finland	**ML**	Mali	**UZ**	Uzbekistan
FR	France	**MN**	Mongolia	**VN**	Viet Nam
GA	Gabon				

PACKAGING MATERIAL, METHOD FOR PRODUCING IT, CONTAINER MADE OF SUCH A MATERIAL, AND USE OF THE MATERIAL FOR MAKING THE CONTAINER

This invention concerns a flexible packaging material which, by thermoforming or other mechanical processing, is mouldable into dimensionally-stable liquid-tight containers intended especially for food and exhibiting barrier qualities.

The invention further relates to a method for producing this material, as well as a container made thereof.

Moreover, the invention concerns the use of the packaging material for making dimensionally-stable liquid-tight containers exhibiting barrier qualities.

As a rule, packaging materials used for making food containers have to exhibit excellent barrier qualities, i.e. the material should have a reduced permeability with respect to, inter alia, oxygen, water/vapour, light or ultraviolet radiation. The requirements placed on the barrier qualities of the material may, of course, vary according to the food that the container at issue is to hold.

Coating the packaging material with an aluminium foil is a highly efficient method of obtaining good barrier qualities. However, the provision of such an aluminium foil makes the packaging material much more expensive, and it is sometimes necessary to cover the aluminium foil with special protective layers in order to prevent direct contact between the foil and the food held in the container.

When used in trough-shaped table packs for butter, the aluminium foil creates special problems. In such packs, the original sealing used is an aluminium foil which is applied over the trough opening and is sealed against the upper circumferential edge portion of the trough. This aluminium foil makes the whole pack more

expensive, not only as a result of the cost of material for the foil, but also as a result of the fairly complicated operations required for applying the cut foil to the pack trough and gluing or heat-sealing it onto the pack.

Another drawback associated with table packs equipped with such an aluminium foil is that the pack will contain metal, such that metal detectors may not be used for checking the contents of the pack.

Yet another drawback is that such a table pack is made of different materials, namely plastic and metal (aluminium), and in some cases also paper and/or board. For purposes of recycling, and thus from the environmental point of view, this is a serious drawback.

Thus, there is a demand for a new packaging material which exhibits satisfactory barrier qualities without the use of any metal foil and which further is less expensive than equivalent materials available on today's market.

Since several European countries are planning to introduce a package tax based on weight, there is an increasing demand for lighter packaging materials. Also, many countries require that all packages should be made of material that is easily recycled.

Thus, there is a demand for a new packaging material which not only has satisfactory barrier qualities and fetches a low price, but which may be of much lighter design than has hitherto been possible. For purposes of recycling, the package should optimally be made of one material only.

It is true that the prior art encompasses packaging materials without any aluminium foil, and one example thereof is taught in SE-B-468,635 (corresponds to EP-A-494,594). This known packaging material comprises a fairly thick, stiffening core layer, which on both sides is provided with a thin protective layer or barrier layer. The core layer consists of a mixture of plastic and filler, and the plastic preferably is a polyolefin, such

as polyethylene or polypropylene. As filler, use is primarily made of chalk, but other possible fillers are talc, mica and clay. The amount of filler should be 50-80% of the total weight of the core layer, preferably about 65% by weight. The protective layers should consist of a mixture of a plastic of the same type as the plastic used in the core layer and some other plastic.

However, this packaging material does not meet the market's requirements on low-weight packages, since the filler in the core layer, if anything, makes the packaging material heavier than comparable prior-art packaging materials, with or without any aluminium foil.

Another example of the prior art is SE-B-467,772 (corresponds to EP-A-494,595), which discloses a packaging material similar to that discussed above.

The prior art further encompasses US-A-4,657,811, which teaches a three-layer plastic film intended especially for the production of trash bags. The drawbacks to be obviated by this plastic film are associated with the fact that trash bags are usually made of a very thin and flexible plastic material, which means that the bags do not have enough strength to stand alone when to be loaded. The trash bags quite simply collapse.

The above US patent therefore suggests a material which comprises a core layer consisting of a foamed thermoplastic, which on both sides is provided with a thin skin layer of polyethylene. The foamed core layer is meant to have a certain stiffening effect. However, the plastic film composed of these three layers is very thin and is unsuited for the production of dimensionally-stable liquid-tight containers for e.g. edible fat. This prior-art three-layer film has a thickness of but about 20-60 µm, the core layer having a thickness of about 6-38 µm, and each skin layer having a thickness of about 6-13 µm.

It is quite easily understood that the three-layer plastic film taught in the US patent need not exhibit

such barrier qualities as have been discussed by way of introduction, since the prior-art film is primarily intended to be used for trash bags. Being very thin, the known plastic film could not possibly be used as packaging material for food.

One object of the invention is, therefore, to provide a new packaging material obviating the above-mentioned drawbacks and meeting the market's requirements as to low weight and low price.

A special object of the invention is to provide a packaging material which ensures satisfactory barrier qualities without the need of any metal foil.

Another object of the invention is to provide a package or container which can be originally sealed without the need of any metal foil.

Yet another object of the invention is to provide a package or container which is made of as few elements and materials as possible and thus is easily recycled.

A further object of the invention is to provide an efficient method for producing the packaging material, as well as to provide a use of the packaging material for making dimensionally-stable liquid-tight containers exhibiting barrier qualities.

These and other objects, which will appear from the following description, have now been attained by a packaging material of the type defined in appended claim 1, as well as a container of the type defined in appended claim 7. Furthermore, these objects have been attained by a method and use having the distinctive features recited in appended claims 9 and 10. Preferred variants of the invention are stated in the appended subclaims.

The invention will now be described in more detail with reference to the accompanying drawings of embodiments. In the drawings,

Fig. 1 is a schematic cross-section of a packaging material according to a preferred embodiment of the invention,

Fig. 2 is a partial section of a container according to a preferred embodiment of the invention, and

Fig. 3 is a schematic view of a plant for producing the packaging material.

Fig. 1 is a cross-section of a preferred embodiment of the packaging material according to the invention. This material comprises a stiffening, polymeric core layer 1 which on both sides has a barrier layer or protective layer 2, 3 (skin layer) of polymeric material connected thereto. In order that the packaging material should have a low weight, the intermediate core layer 1 comprises a foamed thermoplastic, preferably a thermoplastic polyester. The density-reducing foaming operation is carried out by admixing a known foaming agent to the polyester. If based on plastic, the foaming agent includes granulates which, when heated, generate bubbles of gas (e.g. carbon dioxide), which expand the polyester. Preferably, the degree of foaming of the core layer 1 is such that its density is at least 20% lower than that of the protective layers 2, 3, which preferably comprise a non-foamed, thermoplastic polyester. For purposes of recycling, it is preferred that the core layer 1 and the protective layers 2, 3 are based on the same thermoplastic, preferably a polyester. The packaging material should have a thickness of approximately 125-2500 µm, depending on the purpose of the container to be produced therefrom.

In order to achieve good dimensional stability, good barrier qualities and a low weight, the core layer 1, consisting chiefly of foamed polyester, should have a thickness that makes up about 70-95% of the total thickness of the packaging material, and the protective layers 2, 3, consisting chiefly of non-foamed polyester, then make up the remainder of the thickness of the packaging material. Tests meeting these requirements have yielded excellent results.

A liquid-tight and dimensionally-stable container made of the packaging material according to the invention may be composed of only two elements, namely a trough-shaped element 4 and a lid element 5 sealable therewith (see Fig. 2). At its opening, the trough element 4 has a circumferential flange 6 which, after the container has been filled, is applied against a corresponding circumferential flange 7 on the lid element 5. At least the one flange is provided with an adhesive, so as to make the original sealing of the container so tight that there is no need of any sealing by means of a metal foil. When sealing the container, clamping jaws (not shown) are applied against the flanges 6, 7 at a temperature of about 180-200°C and for 0.5-1 s. A highly reliable original sealing of the container is obtained with an application pressure of about 2-5 N/mm^2. In order not to be damaged by the clamping jaws, the flanges 6, 7 may on the outside have a thin coating of a protective lacquer (not shown).

Since only one of the circumferential flanges 6, 7 is coated with the adhesive or glue, the glued surface is very restricted, involving a much-reduced consumption of glue. In the case of similar, prior-art original sealings, the entire inside of the lid has been provided with a so-called thermolacquer for the adhesion of the trough element to the flange. In the inventive container, only the contact surface between the flanges 6, 7 is glued.

It should be observed that the container 4, 5 described above further comprises means (not shown) for resealing, e.g. snap-in sealing.

In a container designed in accordance with the invention and intended especially for edible fat, the trough element 4 has a wall thickness of 300-1200 µm, preferably 450-1000 µm and most preferred 550-700 µm. In the same container, the lid element 5 then has a wall thickness of 125-400 µm, preferably 150-300 µm and most preferred 200-240 µm.

In a container designed in accordance with the invention and intended especially for yoghourt, the trough element 4 may have a wall thickness of up to 2500 µm, while the lid element 5 may be thinner and have a wall thickness equivalent to that indicated above for the edible-fat container.

If a container trough is thermoformed from the material in the downward direction as seen in Fig. 1, the protective layer 2 will form the inner layer of the trough, while the protective layer 3 will form the outer layer of the trough. If the trough is to contain edible fat, the inner layer 2 must, of course, be fat-resistant and should in addition form a barrier against oxygen and water/vapour. As a rule, the inner layer 2 is dyed white. The core layer 1 is advantageously dyed grey, so as to serve as a light barrier. Also the outer layer 3 may be dyed, for instance for decorative purposes. It should here be observed that the outer layer 3 may, in certain circumstances, be dispensed with, if the inner layer 2 and the core layer 1 provide the barrier qualities required.

Fig. 3 schematically illustrates a plant in which the inventive method can be applied. This plant comprises three silos 8-10 for polyester, three driers 11-13, and four tanks 14-17 for colour granulates and foaming agent, as will be described in more detail below. Furthermore, the plant includes three extruders 18-20, one moulding head 21, three cooling rollers 22-24, one thickness gauge 25, one trimming device 26, one mill 27 and one final rolling-up device 28.

The silo 8 contains virgin material in the form of polyester having a viscosity of about 0.8, i.e. the average intrinsic viscosity is about 0.8. Via the drier 11, the polyester is supplied to the extruder 18, whence the material to form the core layer 1 is supplied to the moulding head 21. Foaming agent from the tank 16 and colour granulates, if any, from the tank 17 are supplied

to the core-layer extruder 18. The silo 10 also contains virgin material in the form of polyester having a lower intrinsic viscosity, namely an average intrinsic viscosity of about 0.7. Via the drier 13, this polyester is supplied to the extruder 19 for producing the inner layer 2 and to the extruder 20 for producing the outer layer 3. Colour granulates from the tank 14 are used for colouring the outer layer 3, and colour granulates from the tank 15 are used for colouring the inner layer 2, if any such colouring is to be performed. From the extruders 18-20, the three materials are fed to the moulding head 21, where the materials are laminated at a temperature of about 200-300°C. Via the cooling rollers 22-24, the material web is further conveyed to the rolling-up device 28, which serves as intermediate storage means prior to the thermoforming (not shown) of the containers.

In the trimming device 26, the material web is trimmed, and the waste material is supplied to the mill 27, whence crushed material is returned to the silo 9 and, via the drier 12, to the extruder 18, where the core-layer material is formed. In the crushed polyester material thus recycled in the process, the molecular chains have been so broken that the intrinsic viscosity is below 0.8, and in some cases even below 0.7. Such recycling of crushed polyester enables the process to be controlled in an extremely expedient fashion, as will be described in more detail below.

The core-layer material leaving the extruder 18 may, by suitable control of the recycling process, be brought to an intrinsic viscosity of approximately 0.68-0.82, which thus occurs before the lamination in the moulding head 21. The polyester to form the protective layers 2, 3 after the extruders 19 and 20, respectively, is always supplied in the form of virgin material having an intrinsic viscosity of about 0.68-0.72. Owing to the above recycling of crushed material to the core-layer material, the lamination in the moulding head 21

may be so controlled that the difference in intrinsic viscosity between the core layer and the protective layers at all times exceeds 0.04. This results in excellent lamination.

By feedback (not shown), the thickness gauge 25 may also be used for controlling the above process.

The basic ideas behind the inventive concept have been tested in actual practice, and excellent results have been obtained. Containers having a 50% lower total weight than equivalent prior-art containers and exhibiting perfectly acceptable mechanical properties and barrier qualities have been produced. In the tests, use has been made of polyester material available on the market and having a density of about 1.33 kg/dm^3. By foaming, the density of the core layer is easily reduced by about 20-40%.

It goes without saying that the invention is by no means restricted to the embodiments described in the foregoing, but that several modifications thereof are conceivable within the scope of the inventive concept as defined in the appended claims. Naturally, use can be made of other thermoplastics, and it should be emphasised that minor deviations from the ranges given in the appended claims are conceivable without departing from the inventive concept.

CLAIMS

1. A flexible packaging material which, by thermoforming or other mechanical processing, is mouldable into dimensionally-stable liquid-tight containers intended especially for food and exhibiting barrier qualities, said packaging material comprising a stiffening, polymeric core layer (1) which on one side or both sides has a protective layer (2, 3) of polymeric material connected thereto, said packaging material having a thickness of approximately 125-2500 µm, characterised in that the core layer (1) essentially consists of a foamed thermoplastic and has a thickness that makes up about 70-95% of the total thickness of the packaging material, and that the protective layer or layers (2, 3) essentially consist of non-foamed thermoplastic and make up the remainder of the thickness of the packaging material.

2. A packaging material as set forth in claim 1, which is sheetlike or weblike.

3. A packaging material as set forth in claim 1 or 2, in which the core layer (1) and the protective layer or layers (2, 3) are based on the same thermoplastic.

4. A packaging material as set forth in any one of the preceding claims, in which the core layer (1) has a density at least 20% lower than that of the protective layer or layers (2, 3).

5. A packaging material as set forth in any one of the preceding claims, in which the core layer (1) is made from a polyester foamed with a density-reducing foaming agent.

6. A packaging material as set forth in any one of the preceding claims, in which the thermoplastic of the protective layer or layers (2, 3) is a polyester.

7. A container which is intended especially for packaging food and consists of a trough-shaped element (4) and a lid element (5) sealable therewith, the trough

element (4) having a wall thickness of 300-2500 µm, preferably 450-1000 µm and most preferred 550-700 µm, and the lid element (5) having a wall thickness of 125-400 µm, preferably 150-300 µm and most preferred 200-240 µm, characterised in that the trough element (4) as well as the lid element (5) are made of a packaging material as set forth in any one of claims 1-6.

8. A container as set forth in claim 7, in which the trough element (4) has a circumferential flange (6) at its opening and the lid element (5) has a corresponding circumferential flange (7), said flanges (6, 7) being applicable against each other, at least the one flange being provided with an adhesive for original sealing of the container, and the container further comprising means for resealing.

9. A method for producing a packaging material as set forth in any one of claims 1-6, in which the core layer is produced in a first extruder (18) and the protective layer or layers (2, 3) are produced in a second extruder (20) or a pair of second extruders (19, 20), and in which said layers (1-3) are brought together and laminated in a moulding head (21) at a temperature of approximately 200-300°C, characterised in that the core layer (1) is brought to a viscosity (iv) of approximately 0.68-0.82 before the lamination, that the protective layer or layers (2, 3) are brought to a viscosity (iv) of approximately 0.68-0.72, and that the lamination in the moulding head (21) is so controlled that the difference in viscosity (iv) between the core layer (1) and the protective layer or layers (2, 3) at all times exceeds 0.04.

10. The use of a packaging material as set forth in any one of claims 1-6 for making dimensionally-stable liquid-tight containers, which are produced by thermoforming or other mechanical processing and which exhibit barrier qualities.

FIG.1

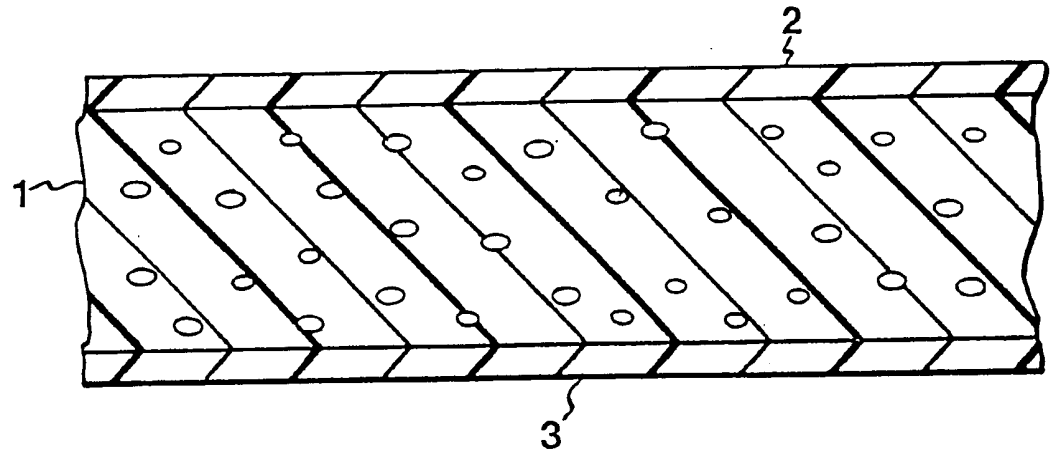
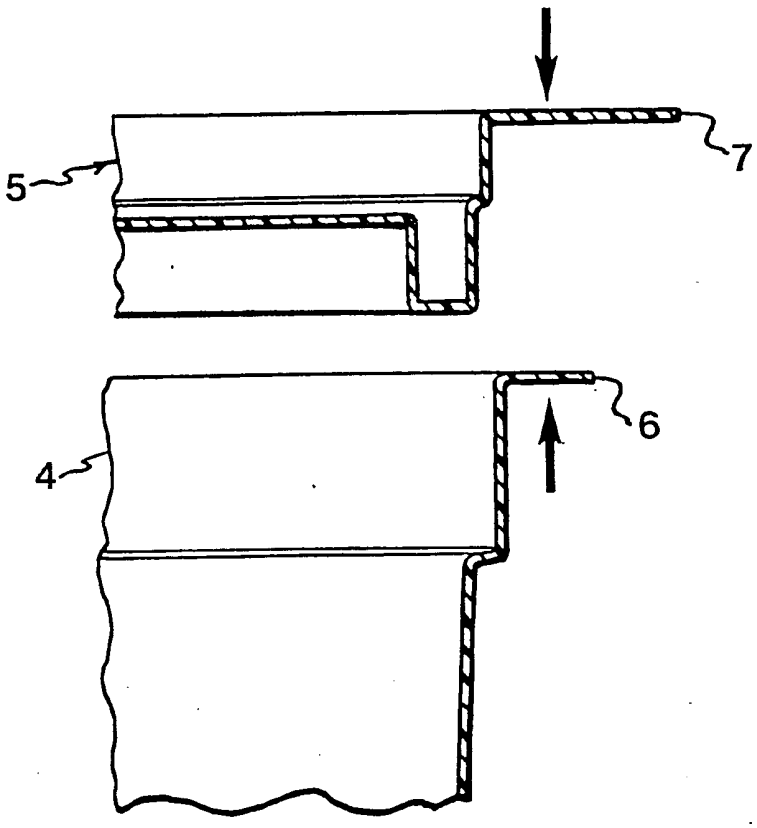


FIG.2



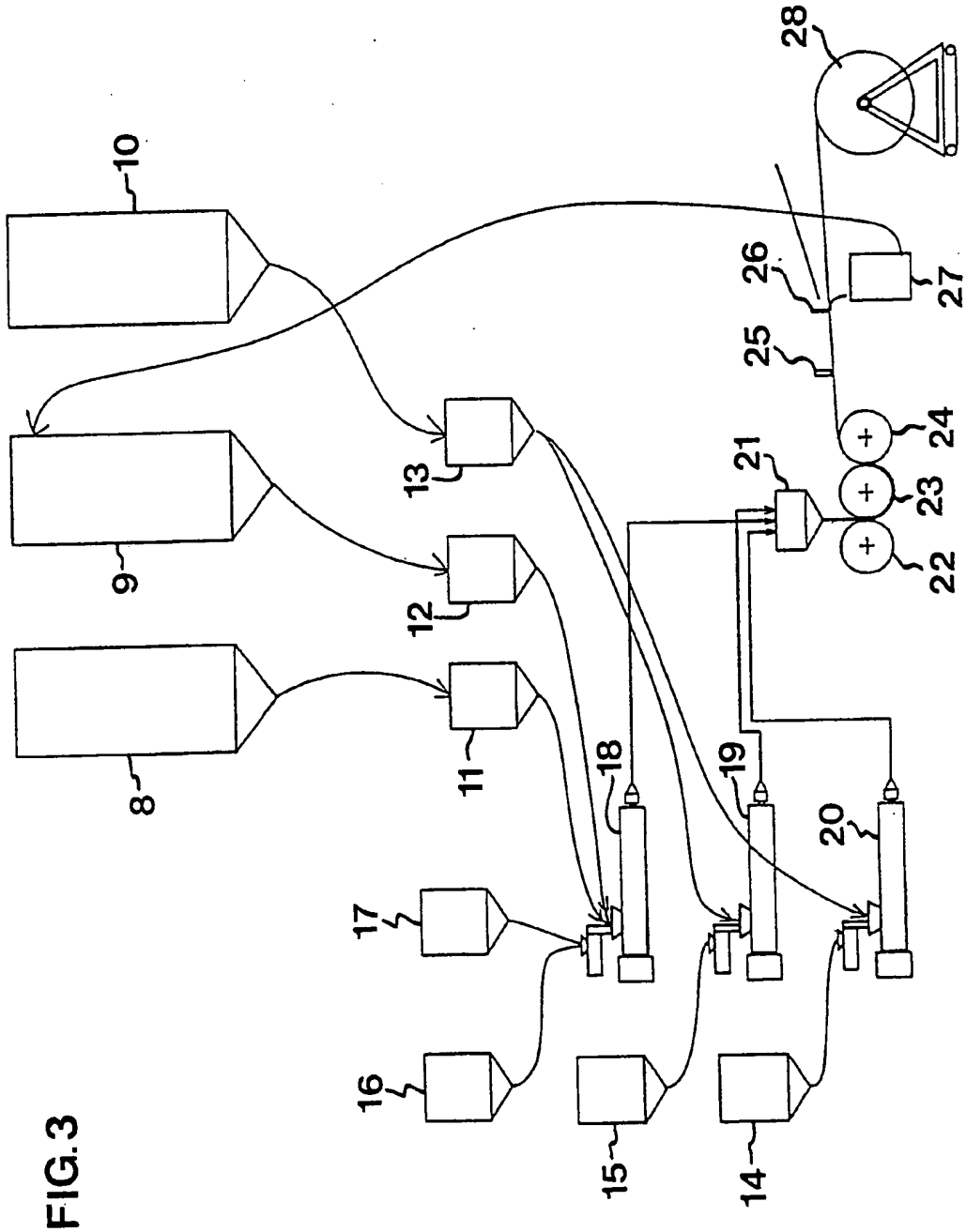


FIG.3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 94/01145

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B32B 5/18, B65D 65/40
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B32B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 5000991 (MOTOSHIGE HAYASHI ET AL), 19 March 1991 (19.03.91), example 50, example 52, claims 1,6,7,18,19,20 --	1-8,10
A	US, A, 4704510 (TAKASHI MATSUI), 3 November 1987 (03.11.87), column 2, line 14 - line 37; column 3, line 24 - line 40; column 3, line 62 - line 66, figure 4, claims --	1-10
A	US, A, 4183435 (KENNETH P. THOMPSON ET AL), 15 January 1980 (15.01.80), see column 1, line 66 - column 2, line 4, line 41 - line 58; claims 1,4, 6,10 -- --------	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 February 1995	06 -03- 1995
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Hans Bäckström Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

09/02/95

International application No.
PCT/SE 94/01145

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A- 5000991	19/03/91	AU-B-	635230	18/03/93
		AU-B-	643402	11/11/93
		AU-B-	650812	30/06/94
		AU-B-	652512	25/08/94
		AU-A-	3546893	20/05/93
		AU-A-	3546993	17/06/93
		AU-A-	3547393	24/06/93
		AU-A-	4579789	07/06/90
		CA-A-	2004300	01/06/90
		EP-A,A-	0372846	13/06/90
		EP-A-	0547032	16/06/93
		EP-A-	0547033	16/06/93
		EP-A-	0552813	28/07/93
		JP-A-	2251543	09/10/90
		JP-B-	6088301	09/11/94
		JP-A-	3111244	13/05/91
		JP-B-	6098982	07/12/94
		JP-A-	3134037	07/06/91
		JP-B-	5083573	26/11/93
		JP-A-	2150434	08/06/90
		JP-B-	5015736	02/03/93
US-A- 4704510	03/11/87	CA-A-	1225606	18/08/87
		EP-A,B-	0128425	19/12/84
		SE-T3-	0128425	
		JP-A-	59210168	28/11/84
		JP-A-	60002512	08/01/85
		JP-A-	60024563	07/02/85
US-A- 4183435	15/01/80	NONE		